Remarks

Amendments to the Claims and the Section 112 Rejection

Independent Claim 1 has been amended to delete the phrase "a chemically equivalent quantity of." The Examiner has objected to this phrase as not having support in the specification as required by Section 112. But the specification does support the reaction of a chemical equivalent amount of hydride and water. Referring to Applicants' published application US 2005/0191234 A1, paragraphs 0105-0111 (for example) clearly show that a hydride is reacted with a chemically equivalent quantity of water. The equation in paragraph 0106 (the reaction arrow is missing in the printed equation) shows that chemically equivalent amounts of hydride and water are reacted to form a hydroxide and hydrogen. The equation in 0107 and 0110 shows the reaction of equal molar amounts of LiH and water which are chemically equivalent amounts of these reactants.

In Independent claim 72 the water is provided in the form of a hydrated hydroxide as described paragraphs 0115-0132. This disclosure, including the several reaction equations in paragraphs 0124-0132 disclose that "the quantity of hydride is substantially chemically equivalent to the water content and hydroxide content of the hydrated hydroxide. For example, in the equation of paragraph 0124 (reaction arrow missing in this printed text) three moles of lithium hydride are reacted with one mole of lithium hydroxide containing one water of crystallization. The chemical equivalency is clearly disclosed.

Still, in considering the Examiner's objection and rejection under 35 U.S.C. 112, Applicants' attorney has deleted the precise "a chemical equivalent" limitation in claim 1 as being too limiting. The Examiner has suggested use of the phrase "sufficient to react." This suggestion is gratefully acknowledged. However, it is believed that the remaining phrase in claim 1, "...reacting a first portion of particles of a hydride with water to produce heat in a first reaction and reacting,..." implies and requires that the respective amounts of the first portion of particles and water are sufficient for the heat producing reaction. It is believed that, as amended, claim 1 meets the requirements of Section 112 and is patentable over previously applied prior art.

Similarly, independent claim 72 has been amended to delete the phrase "substantially equivalent to." Claim 72 has further been amended, as suggested by the Examiner, to state that

the quantity of the hydride particles is sufficient to react with the water content and hydroxide content of the particles of hydrated hydroxide for the specified solid state reaction. It is believed that, as amended, claim 72 meets the requirements of Section 112 and is patentable over previously applied prior art.

Status of the Claims

With the above amendments, claims 1-12, 14-29, 48-49, 54-55, 57, 59-61, 63-66, 72-82, 84 and 88 of the currently amended application are presented for further consideration.

The Claim rejections under 35 U.S.C. 112

Claims 1-12, 14-29, 48-49, 54-55, 57, 59-61, 63-66, 72-82, 84 and 88 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. It is respectfully requested that each of these rejections be reconsidered and withdrawn for the reasons given in the above Amendments to the Claims section of this paper.

If there are unresolved issues concerning claims 1 and 72 that could be discussed, the Examiner is invited to call Applicants' attorney at the number provided below.

The Claim rejections under 35 U.S.C. 102(b)/103(a)

Claims 67-71 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Machin et al. ("Kinetics of the Reaction of Water Vapor with Crystalline Lithium Hydride").

It is respectfully requested that each of these rejections be reconsidered and withdrawn for the following reasons.

Method claim 67 recites a method of producing hydrogen using particles of a hydride present in a first (hydride-containing) material composition and particles of a hydroxide present in a second (hydroxide-containing) material composition. In the practice of the claimed method the hydride particles and hydroxide particles are mixed with each other. As illustrated in the five specific examples of the specification, the mixture may be prepared with well mixed, ball milled particles for the stated second reaction between the hydride particles and hydroxide particles. Water is reacted with a portion of the hydride particles in the mixture to produce heat. The water/hydride reaction likely produces hydride and hydrogen, but it is conducted so as to

produce heat to initiate a second reaction, a solid-state reaction within the mixture. The solid-state reaction occurs between other hydride particles and hydroxide particles intentionally placed in the mixture. The solid state reaction is conducted to produce hydrogen and an oxide byproduct.

Method claim 67 is conducted to produce hydrogen using a mixture (an existing mixture) of solid particles. The express language of claim 67 doesn't require that the proportions of hydride and hydroxide be managed to maximize hydrogen production from a starting mixture of hydride and hydroxide. But certainly one skilled in the art of hydrogen storage preparing such a hydrogen storage mixture would try to get as much hydrogen as possible from a mass and volume of the storage material. The steps and recitations of claims 67-71 enable such a result.

The Examiner states that Machin et al. teach a method for producing hydrogen (referring to page 2205) wherein lithium hydroxide hydrate is reacted with lithium hydride in particle form (page 2206) in the presence of water to produce hydrogen (2217). The Examiner asserts that Machin et al thus teach that water, lithium hydroxide, and lithium hydride could be present at the same time in the lithium hydride crystals used in their kinetics studies. The Examiner then concludes that "reaction of the instant claims would be inherently taught." Applicants' respectfully argue that this Machin teaching neither anticipates, nor makes obvious, the methods recited in any of claims 67-71.

Machin et al seek to study the kinetics of the reaction between solid lithium hydride and water vapor. They start with a synthetic LiH and "remove LiOH impurity from the hydride." They commence their kinetic studies by reacting water vapor with the purified LiH. They observed that the reaction of water vapor with lithium hydride could produce either lithium hydroxide or lithium oxide as a solid product, or both. Various possible chemical reactions of lithium hydride with water, or with lithium hydroxide, or with hydrated lithium hydroxide are described in the Machin et al paper. But neither the Machin kinetic studies nor their statement of the respective lithium hydride reactions can be said to anticipate Applicants claims 67-71.

Applicants' claim 67 explicitly describes mixing particles of a hydride composition and separate and distinct particles of hydroxide composition as a hydrogen storage material. Applicants' method is practiced to first generate suitable heat within the storage material to produce hydrogen on demand. Water is reacted with a portion of the hydride particles to

promote a solid-state reaction between other particles of hydride material and particles of hydroxide material that are already a part of a hydride/hydroxide mixture. The hydroxide particles are not claimed to be formed as intermediate, water-reaction byproducts in a body of lithium hydride particles. Applicants' method is practiced using hydroxide particles pre-mixed with hydride particles. Applicants' claimed methods permit a timely and maximum release of hydrogen from a given mass of premixed hydride particles and hydroxide particles.

Machin et al., by contrast, perform careful purification measures to ensure that LiOH, which they view as an impurity (page 2206, line 7 of the Experimental, Materials section), is not initially present with the lithium hydride. The reaction of lithium hydride and lithium hydroxide which they observed was associated with LiOH as a reaction product of the initial reaction of LiH and water. The Machin et al disclosure does not provide lithium hydroxide pre-mixed with lithium hydride to increase and hasten the release of hydrogen. In Machin, the hydroxide is formed in some uncertain byproduct form in the hydride material. As such a reaction product, the hydroxide material may not be in a form or location for easy reaction with the original hydride particles. In Machin, the presence of lithium hydroxide or hydrated lithium hydroxide must await an unmanaged reaction between water vapor entering a mass of lithium hydride particles. The Machin method is simply contrary to Applicants' efficient method for efficiently releasing hydrogen from a hydrogen storage material. Thus Machin et al. fails to explicitly recognize 'each and every element of the claim' and applicant thus respectfully requests withdrawal of the 102(b) rejection.

Nor does the Machin et al paper justify any 103(a) rejection of the Applicants' claims.

The Machin paper is not really related to hydrogen storage and release. It does not suggest a method of reacting water with a portion of particles of a hydride in a mixture with particles of a hydroxide. Machin does not suggest exploiting the heat of a water-hydride reaction to promote a concomitant reaction between other hydride particles and hydroxide particles in the same mixture. Applicants' claims 67-71 methods produce hydrogen and an oxide. As stated above, the claims 67-71 methods permit a maximized amount of hydrogen to be released quickly from a hydrogen storage mixture of hydride particles and hydroxide particles. An oxide is formed from which the hydride and/or oxide may be regenerated. Such hydrogen storage and production practices are not suggested by the Machin et al paper.

For the reasons stated, it is requested that the rejections of independent claim 67 and its dependent claims 68-71 be reconsidered and withdrawn.

Since independent claims 1, 67, and 72 are believed to be patentable, it is also requested that the withdrawn claims also be considered in this application and that they be allowed.

If there are unresolved issues concerning this application that could be discussed, the Examiner is invited to call Applicants' attorney at the number provided below.

Respectfully Submitted,

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